KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, DECEMBER 29, 1882.

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Science and Art Gossip.

And now the end of the world is to come in 1886, *vice* 1882 departed.

But the comet, according to the latest estimate of its orbital motion, is not to return for 4,000 years,—though it *did* travel so close along the orbit of the comets of 1843 and 1882.

Between ten and eleven o'clock on Dec. 21, the attention of several persons in Broughty Ferry was directed for a time to a somewhat unusual sight in the heavens. The sun at the time was shining brightly, being about due south, when a star was seen in close proximity to it. The star was a little above the sun's path, and the peculiar phenomenon was seen by various persons, who had their attention directed to it. Being daytime, the star did not have the brilliant luminous radiance stars exhibit at night, but was of a milky white appearance, and seemed, when seen through the glass, to be of a crescent shape. Being on a light blue ground, and lying between two white clouds, it was seen to great advantage.

"De mortuis nil nisi bonum" seems to be precisely the reverse of the usual custom. For we never hear any man abused so roundly in life, as he is when, being dead, he can no longer defend himself. At least, it is so in public life. Perhaps, because a man who is in power, or may rise to power, is regarded as one whom it is best to treat respectfully—with due reference to what De Morgan called the "way up in the world." Anyhow, we never hear the worst that can be said of such men till after they are dead.

For instance, here are the words of a statesman, recorded by a bishop, who filled a greater space in public life than the innocuously neutral Tait, and had so pleasantly (to all seeming) rounded off his idiosyncratic corners that he was generally known as Saponaceous Samuel (or to that effect) respecting one who was certainly presented to the British public by omniscient newspapers as a great and chivalrous (not horsey) statesman: —

Clarendon spoke to me with the utmost bitterness of Lord Derby. He "had studied him ever since he (Clarendon) was in the House of Lords. No generosity, never, to friend or foe; never acknowledged help; a great aristocrat, proud of family wealth. He had only agreed to this (the Reform Bill of 1867) *as he would of old have backed a horse at Newmarket;* hated Disraeli, but believed in him *as he would have done in an unprincipled trainer; he wins, that is all.* He knows the garlic given, &c. He says to those without, 'All fair, gentlemen.'"

It was reported recently in certain daily and weekly papers that Colonel Keyter had done some heliographic signalling from the top of the Great Pyramid which had been read at Alexandria—a distance of 120 miles. As we pointed out in these columns, the thing was impossible, as the depression at each of a tangent line to the earth's surface, 120 miles long, and touching at its middle point, is $(60)^2 \times$ depression for 1 mile or (with due account of refraction) about 3,600 times 6 in., or 1,800 ft.—nearly four times the height of the Great Pyramid. We were invited to write to Colonel Keyter, asking under what conditions his signalling was made; but we were not very anxious to ask a question akin to, say, "Under what conditions did you see through a millstone?" But Mr. Hampden (who really *must* believe in the earth's flatness!) did so.

Colonel Keyter explains that his signalling was slightly exaggerated; it was at *Cairo*, not at *Alexandria*, that the signals were read—a distance of about 12 miles, instead of 120. The depression for the whole distance of 12 miles would be about 72 feet, or less than a sixth of the Great Pyramid's height.

A correspondent writes that Adam's Peak, in Ceylon, some 7,400 feet high, can be seen in clear weather a distance of 150 miles; but he does not say *whence*. If from the deck of a ship, I question the distance mightily, and doubt the captain's judgment of his position. If from a height of not less than 300 feet above the sea, and the barometric pressure high, so as to bring the effects of refraction to a maximum, which would make the depression for a mile rather less than $5\frac{1}{2}$ inches, the tangent line to the sea surface would touch 26 miles from the ship, and the remaining 124 miles would correspond to a depression of $(124)^2 \times 5\frac{1}{2}$ inches, or about 7,040 feet. This would leave 200 or 300 feet of the peak visible.

Messrs. Campbell, a firm of dyers at Perth, have adopted the electric light, and are well pleased with it, finding that the purity of the light enables them to distinguish colours perfectly, and to carry on at any hour operations which could be otherwise only performed by daylight.

Electric Light Companies received a somewhat severe rebuff the other day at the hands of Mr. Justice Chitty. A disappointed shareholder sued one of the subsidiary Brush Companies for the return of the money he had paid in. The claim was based on the fact that whereas the Lane-Fox incandescent lamp is the property of the British as well as the Brush Electric Light Companies, he took up his shares on the representation that the Brush Company had sole right to use it. The application was opposed on the ground that if a misstatement had been made it was not material, since the Lane-Fox lamp was the least valuable of the inventions conceded to the Company by the Anglo-American Corporation. Mr. Justice Chitty

said that it was plain to an ordinary mind that there had been a misstatement which was material, and calculated to mislead the applicant. His lordship also thought that it was not competent for persons who had issued a prospectus which had recommended as one of its leading attractions this particular invention, to afterwards say that the invention was of little or no value. The application must therefore be granted with costs, and the sum paid in respect of the shares returned to the applicant by the Company.

"A very disreputable breed of flies," says the *Friend of India*, "appears to have its habitat in that sacred abode of learning, the Presidency College (Bengal). They are neither Hindu flies nor are they Mussulman, or else they are sadly perverted and depraved, for the dissolute little insects are so shamelessly fond of intoxicants, that no sooner does a Professor, who has been fortifying himself for his arduous labours with a peg, present himself in the class-room, than they swarm about his lips, revel in the breath of his mouth, and drain the dews of his moustache. Their conduct must, we should think, be extremely troublesome to the pegging Professor; but that is not the worst of it. The students know well what is signified by the swarm of flies on the Professor's lips. They know that their revered instructor has been indulging in strong liquors, and it is feared that they may desire to imitate him by turning their innocent and scarce yet downy lips into taverns for the bibulous flies. This is the serious side of the humorous picture drawn by our respected contemporary, the *Brahmo Public Opinion*, who exclaims:—'Fancy the picture of a Principal and Professor coming to that class, with the perfume of wine about his person, and with flies obstinately chasing his mouth; what an edifying sight is that!' Edifying, indeed! We join with our contemporary in advising the Principal and Professors of the Presidency College to abstain from wine and pegs till after college hours—unless they can exterminate that abandoned breed of flies that chase the bibulous mouth."

A trial of the Jürgensen dynamo machine has been made by the Danish Government. It was compared with the Gramme machine. The following table will show the average of four days' working:—

	Gramme.	Jürgensen.
Revolutions per minute	475	400
Normal light	28,890	40,000
Temperature between the ring after 4 hours	30°R	25°R
Resistance in the dynamo in Ohms	0·424	0·390
Length of wire on the magnets in mètres	3,160	330

From this it will be seen that the Jürgensen dynamo gave 38 per cent. more light than the Gramme, while, at the same time, the Gramme required about 90 times as much wire as its competitor.

Subterranean telegraph cables are being laid in Strasburg to replace the aërial wires previously employed. The cables will be laid in trenches about 3 ft. deep.

The Preservation of Lemon Juice.—A correspondent in *Mém. de Méd. et de Pharm. Milit.* says, after various experiments and the test of eight months' exposure to the sun and heat of summer, he has come to the following conclusion:—"Heating the juice or adding alcohol to the same would appear to be superfluous, as it is only necessary to filter it and keep it sealed in bottles; however, since filtration proceeds very slowly, the best way is, perhaps, to add 10 per cent. of alcohol to the fresh juice, and bottle. The *Pharmaceutical Journal* observes that it may be preserved without the addition of alcohol by heating it to 150° Fah., and then excluding it from the air by carefully closing the full bottles at this temperature. The operation should be carried out in winter.

A correspondent, writing from Middlesbrough, remarks that there the Christmas Carol to which we referred in our last as almost always misquoted, "God rest you, merry gentlemen," is rendered thus:—

> God arrest you, merry gentlemen;
> Let nothing you dismire,

—a reading worthy of Dogberry himself. God rest us merry!

Referring at the Society of Arts the other day to the recent calamitous fire in the City, Mr. W. H. Preece called attention to the many automatic fire-alarms now before the public. These cheap as well as ingenious instruments are certainly calculated to meet a great want, which must render itself more and more apparent as time goes on.

We receive many letters showing that readers like those occasional Gossip notes in which we touch on our personal views, thoughts, plans, and so forth. But there are one or two dull souls who cannot understand why we do this. They tell us we should prefer *stare super antiquas vias*, to keep up the usual editorial dignity, and so forth. They point out that the Editor of this journal or of that magazine does not talk thus familiarly with his readers—does not (above all things) note and correct his own mistakes with those of others. We know it. We choose our own way, because we like it much better. We prefer to have no pedestal on which to assume statuesque editorial dignity.

Mr. Edward Clodd, author of the "Childhood of the World," &c., &c., and contributor of articles on the "Antiquity of Man," &c., to the first two volumes of Knowledge (reprinted, with additions, in our forthcoming volumes, "Nature Studies" and "Leisure Readings"), will contribute to early numbers of Knowledge a series of papers on the "Origin and Growth of Myth, and its survival among civilised peoples in their folk-lore, traditions, and beliefs." These will probably be followed by papers on the place of Dreams in savage philosophy, as further contributory to the subject of human progress.

Also, for the volume which begins with No. 62, several series of articles will appear, among them the following:—

"A Naturalist's Year," by Mr. Grant Allen.
"Our Bodies," by Dr. Andrew Wilson.
"Pleasant Hours with the Microscope," by Mr. H. J. Slack.
"Nights with a Three-inch Telescope," by F.R.A.S.
"The Chemistry of Cookery," by Mr. W. Mattieu Williams.
"Sociology," by Mr. Thomas Foster.
"Sun-views of the Earth in the Seasons," illustrated;
And "The Southern Skies," by the Editor.

Besides these, there will be articles on "Electricity," "Chemistry," "Entomology," "Geology," and "Health Resorts," the series on "How to Get Strong" will be continued, and the columns of "Mathematics," "Whist," and "Chess" will be continued weekly. For the present, the "Easy Lessons in the Differential Calculus" will be replaced by simpler mathematical subjects; but they will ere long be resumed, until so much of the subject as can conveniently be dealt with in these pages has been completed.

XUM

THE STAR IN THE EAST.

By Richard A. Proctor.

IT has been suggested by Ideler (1826) that the star which the magi saw in the East was in reality a conjunction of the two planets Jupiter and Saturn. In point of fact, no less than three conjunctions of these two planets occurred in the year 7 B.C., or, remembering the error of four years in the ordinary dating of the year from which the Christian era is reckoned, in the third year before the birth of Christ. On May 29, in that year, the two planets were within a distance of about one degree from each other, or about twice the apparent diameter of the moon. On Sept. 30 they were again at about the same distance from each other, and on Dec. 5 they were for yet a third time almost exactly at the same distance apart. On Sept. 30, in the year 7 B.C., the two planets must have presented a very striking appearance, since they were then both nearly at their brightest.

Ideler's calculations were not quite so exact as those I have here dealt with (which are Encke's). Yet even Ideler's imperfect calculations made it clear that the two planets could not have been less than half a degree from each other—a distance equal to about the apparent diameter of the moon. Ideler, therefore, in order to explain how the two planets came to be mistaken for a single star, was obliged to introduce the subsidiary theory that the magi were very shortsighted, insomuch that the images of the two planets appeared to them to form in appearance a single star of exceptional brightness. When Encke, in 1831, announced the result of his calculations as setting the planets about one degree apart at each of their three conjunctions in the year 7 B.C., Ideler withdrew this fanciful notion. For though to a very shortsighted person the image of a star may appear a little larger than the moon, and thus two stars separated by a distance equal to the moon's apparent diameter might seem to coalesce into a single blurred image (shaped somewhat like the dumb-bell nebula, yet assuredly two stars separated by twice this distance could not possibly be mistaken by the magi for one, unless we suppose those worthies to have been miraculously shortsighted, which does not appear from the narrative. Therefore Ideler now only maintained that the unusual conjunctions of Jupiter and Saturn in the third year before the birth of Christ formed the special astronomical phenomenon which announced to the magi the approaching birth of the great King, whose "kingdom was not of this world." Singularly enough, Dr. Farrar, whom we would suppose unlikely to be led astray by astronomical fancies, adopts in his "Life of Christ" the strange theory thus advanced.

If we consider carefully the narrative given by Matthew, and especially if we consider it from the point of view of those theologians who believe in verbal inspiration, it will appear that this explanation of the Star in the East is altogether inadmissible. It will be well thus to examine the account, one of the most suggestive and poetical in the Gospels, and altogether the most poetical in the Gospel of Matthew. It is well worthy of study in whatever way we view it, whether we regard it as an inspired narrative, true in every detail, or whether we consider it as a tradition only, or whether, lastly, we take some view intermediate between these extreme opinions. Here, however, I only note those features of the narrative which might be apt to escape attention, not to run through the entire account, with which every one may be supposed to be perfectly familiar. I follow the Greek version, not that our translation is inaccurate, but because there are one or two sentences which might be wrongly understood in the English version, while their meaning in the Greek is unmistakable.

Christ was already born in Bethlehem, but how long before we do not know, when certain magi, or persons possessed of occult knowledge, came from the East to Jerusalem. Probably they were supposed to have come from Chaldea, since their wisdom is manifestly associated with the interpretation of the stars, for which the Chaldeans were in those days, and had been for ages, famous. The use of the word "magi," even if we translated it "magicians," would not of itself imply anything objectionable in their wisdom, although the same word is translated "sorcerer" when applied to Elymas, and is used in a somewhat similar sense in the case of Simon Magus. For in the East, the possession of magical power or wisdom was not necessary, or, indeed, chiefly regarded as evidence of wickedness, but frequently as the reward of special virtue. Be this as it may, it is certain that Matthew's narrative attributes a good purpose to the magi who came from the East to worship Christ—though some of the consequences of their journey were, to say the least, unfortunate. They knew from the star or celestial phenomenon which they had observed that one was born who was to be King of the Jews, and they had, therefore, come to Jerusalem, the chief city of the Jews, to ask for more precise information. Astrology, according to the teaching of its leading professors in those days (as, indeed, now), affords the means of determining what region of the earth is indicated by some special phenomenon, though not of assigning the exact part of that region which is in question.

The magi learned from Herod that Bethlehem of Judea was the place where the Messiah was to be born. He had obtained this information from the chief priests and scribes, who interpreted as a prediction to that effect certain words of the prophet Micah. So soon as the magi had been told this they set out from Jerusalem toward Bethlehem, or in a nearly southerly direction. We may suppose that, as Longfellow sings—

> They travelled by night and they slept by day,
> For their guide was a beautiful, wonderful star.

And the star which they had seen in the East went before them till it came and stood over where the young child was. This would imply, if we suppose that they reached Bethlehem near the middle of the night, that the star or orb which they regarded as signifying the coming of a great king was nearly in opposition to the sun at the time when they reached the village where the child was. We must remember, however, in reading this account, that the distance which the magi had to journey was not great—not more, certainly, than six miles. Supposing them to be very feeble old men, and to be heavily burdened with their gifts, which seems hardly probable, since they had come to Jerusalem from a distant country, they could hardly have been more than three hours at the outside upon their journey, if they set out from Jerusalem as the shades of evening closed, and the time was winter, as commonly received, then it would have been about eight in the evening at latest when they reached Bethlehem. And if at that hour the star lay due South, or rather to the west of South, then it must have been sixty or seventy degrees West of the point opposite the sun. This would correspond fairly with the case of the conjoined planets Jupiter and Saturn in the third year before the birth of Christ, if we suppose the journey to Bethlehem made nearly at the time of the third conjunction of those planets, or about December 5. It is, in fact, on this circumstance chiefly that the

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planetary conjunction theory of the Star in the East has been based. But the whole character of the narrative is opposed to this interpretation, apart from the fact that the taxing of the Roman Empire by Augustus, when Joseph and Mary went up to Bethlehem (according to Luke's account), certainly did not take place till two years after the triple conjunction of Jupiter and Saturn. For Matthew says, "Lo! the star went before them," &c., and "when they saw the star, they rejoiced with exceeding great joy." But they would not have lost sight of the planets Jupiter and Saturn from the time when these two planets had been visible in conjunction as morning stars in May (B.C. 7) through the time of their greatest conjoined brilliancy in September, and onward until the time of their third conjunction on Dec. 5. We had a similar triple conjunction of Mars and Saturn in the year 1877. They were conjoined as morning stars on July 27, conjoined when nearly at their full brightness on Aug. 25, and conjoined again as evening stars on Nov. 3. But all through those months they were both visible and in tolerably close proximity. The exceeding great joy with which the magi again saw the star shows that it had been for a time lost to them, so that we must on this account reject the planetary conjunction theory which seems otherwise (and on several grounds) altogether untenable.

I do not know whether any other astronomical interpretation than the one I have just considered has been given to the account of the Star of Bethlehem—at least in a definite scientific manner. The idea has been thrown out that a comet may have been the magi's celestial guide. Others, again, think that the phenomenon was not astronomical at all, but that some mysterious light made its appearance in the upper regions of the air and guided the magi on their way. Even if we adopted this view, though the narrative seems very distinctly to imply that the object seen was some celestial body, the observed event, apart from its miraculous interpretation, belongs distinctly to the domain of science. I do not say it is to be explained as a simply natural phenomenon, but even if a supernatural meaning is to be assigned to it, science, though it deals only in the investigation of natural phenomena, is interested—one may say is doubly interested—in this case wherein (on this view) a phenomenon really supernatural appeared to ordinary observation to resemble so familiar an appearance as a star or asterism (for the Greek word will bear more than one interpretation). The narrative, like the Bible account of the Creation, the description of the standing still of the sun and moon at the command of Joshua, the going back of the shadow on the dial of Ahaz, the account of the visibility of all the kingdoms of the earth from an exceeding high mountain, and so forth, is one which science is clearly entitled to discuss in all its bearings. Even if science accept the supernatural interpretation, it is still its office to discuss the observed facts, for on such scientific discussion depends our opinion of the quality and significance of the miracle.

It is not necessary for science to pretend to explain the narrative in its religious bearing, or even to say what that bearing may be. Science might fail to show why certain Eastern magi—presumably astrologers—were to be enlightened by this new celestial object, whatever it may have been. The prophecy of Micah had, it would seem, to be fulfilled, and it was so. That this fulfilment should have caused the slaughter of the innocents, again, when (as we might imagine) the same result might have been brought about without that unsatisfactory episode, is a point which the theologian and not the student of science is entitled to explain. But when a star is mentioned in the Bible, as anywhere else, the astronomer, following in effect the rule which forms the motto on the seal of the Astronomical Society—*quidquid nitet notandum*—is bound, or is, at any rate, free, to inquire about that star, its recorded movements, its probable brilliancy, and so forth, so far as such points can be inferred from the narrative. Students in another department of science are entitled to deal with this narrative because of the evidence which it seems to afford respecting the prevalence in long past ages of those astrological fancies which remain even in our own time, though with the gradual spread of information respecting astronomy their influence is manifestly diminishing.

THE CRYSTAL PALACE ELECTRIC AND GAS EXHIBITION.

THIS display, which was formally opened on the 13th inst., is scarcely worthy to be called an exhibition. The Electric Exhibition of last winter, it will be remembered, was several months in getting ready, and its official opening did not take place until its course was well-nigh run. Nevertheless, so far as the Palace Company was concerned, it was a great success. The public flocked in crowds unknown for years past. True, they had their reward, for never had there been so gorgeous a flood of light as then illuminated the length and breadth of the Palace, and latterly the terrace as well. Lectures were given, at first of such a character as to interest and instruct uninitiated audiences; but towards the close of the course they seemed to be stamped very plainly with an advertiser's brand. Outside the lecture-room, several of the exhibitors wisely appointed gentlemen to explain their apparatus. Vast sums of money were thus expended, although, we fear, in many cases, with little chance of return. To an outsider, all seemed to be working harmoniously towards a common end, but close beneath the brilliant surface was flowing an undercurrent which has told terribly upon the present exhibition. A gold-thirsty company could only drain its goblet once, and many were the murmurs of discontent which wafted themselves upon the ears of a watchful listener.

To crown all this, a jury of gentlemen was formed (amongst whom were many more or less intimately associated with various exhibits), who to drown the voice of jealousy, and, at the same time, to give a sprat for the whale that had been caught, appear to have bestowed medals and honours broadcast. What is the result? This year the electric exhibitors, which at one time were expected to be sufficiently numerous to fill another electric exhibition, are exceedingly few, and, nominally, cover considerably less than half the space occupied last year. We search the catalogue in vain for such names as Edison, Brush, Hammond, Siemens, Swan, Maxim-Weston, H.M. Government, the Cable Companies, and a host of others who contributed so considerably towards last year's success. In the Electrical section, therefore, we must this year be satisfied with small mercies. The Mackenzie lamp is again displayed, there being three of these arc lights exhibited by Messrs. Strode & Co., who also possess one of the most tastily-arranged displays of incandescent lamps (Swan's) it has ever been our pleasure to behold. In the Alhambra Court, which, it will be remembered, was prettily illuminated last year by Lane-Fox lamps, there are some Werdermann lamps. They were not going well while we watched their performance, and the cause was not far to seek, for on adjourning to the dynamo room (the

one occupied last year by the Brush Company), we saw a more brilliant "armature-fire" than we had ever seen before. The brushes or collectors were not making contact with the commutator at the proper points, and consequently, the current fused them at a great rate, the characteristic green flame of copper illuminating the dynamo and the space around it, and, frequently, pieces of red-hot copper flying off in various directions. It is surprising to us that the insulation on the field magnet underlying the commutator was not set on fire, or, at least, electrically destroyed.

The Roman Court is occupied by an "Electric Bazaar," and here our feelings received a severe shock, for on the tables were a number of Voss machines,* all of them with the fixed plate placed out of position in such a way that they could not be put right without either the vertical or horizontal combs being removed. The attendant was, of course, unable to get a spark, and to account for the failure informed inquirers that *the weather was too damp!* Along the centre of the north nave are several miscellaneous exhibits, few of them, however, being far advanced in preparation. They should be illuminated in the evening by various forms of electric light, but the three Mackenzie lamps are the only ones at present visible.

The gas exhibits are by far the more important and interesting, and are also much nearer completion than those in the electrical section. A fund of upwards of £5,000 has been subscribed by the various gas interests; and accordingly a very representative exhibition may be anticipated. The south nave is well lighted by Sugg, Bray, Siemens, Strode, Heron, and others; but of these we will speak more fully hereafter. The West Corridor is well stocked with gas-engines, cooking and heating apparatus, &c., and in other adjacent portions of the palace a crowd of very interesting exhibits are, or soon will be, open to inspection. Not the least interesting object is Pintsch's patent gas apparatus, by which a railway passenger carriage is lighted for 36 or 40 hours with one charging of gas. The charging is said to be effected in less than a minute. A cylinder underneath the carriage holds the specially-made oil gas at a pressure of 90 lb. This is being constantly reduced by the consumption at the burners, but the patent regulator always brings the gas to them at the proper burning pressure. The cost is claimed to be less than half that of the usual railway oil lamp, and several British railways are using the light. Equally interesting is Pintsch's nine-feet spherical gas-buoy, with lantern and dioptric lens. It is charged with oil gas, and will burn for three months continuously, the light being visible for six miles. By the time this notice appears, the Gas Exhibition will be nearly completed and very interesting, but the North Nave is doomed to remain in semi-darkness for some weeks.

CORSETS AND HEALTH.†

By Dr. Dio Lewis.

STRENGTH AND ACTIVITY OF WOMEN WHEN UNHAMPERED BY CORSETS.

THE Boston Normal School for Physical Education trained and graduated 421 teachers of the new School of Gymnastics. The graduates are about equally divided between the sexes. A considerable proportion of the women were school-teachers in broken health, seeking in the new profession a better means of living. The average health of the women was, in the beginning, lower than that of the men. But, with the removal of the corset and the long heavy skirts, and the use of those exercises which a short and very loose dress renders easy, a remarkable change ensued. In every one of the ten classes of graduates, the best gymnast was a woman. In each class there were from two to six women superior to all the men. In exhibiting the graduating classes from year to year on the platform of Tremont Temple, women were uniformly placed in the more conspicuous situations, not because they were women, but because they were the finer performers. Dr. Walter Channing, who was one of the professors in this normal school, often spoke with great enthusiasm of the superiority of the women.

A convincing experiment was made upon a large number of girls at Lexington, Mass. A school for young ladies was announced and large buildings prepared. During four years of personal management by the founder of the school, nearly three hundred young women were subjected to a new and peculiar regimen, to determine the possibility of improving their bodies during their school-life, as the bodies of young men are improved in some of the German universities. An exceptionally full curriculum of studies was adopted, and a large corps of teachers, including such distinguished names as Theodore D. Weld, Catherine Beecher, and Zerdahelyi, laboured with enthusiasm in the brain-work. The pupils were pressed harder, probably, than in any other school in New England. The girls averaged about seventeen years of age, and came from all parts of the country, including California, Central America, and the West Indies. They were largely from wealthy families—delicate girls, unable to bear the artificial life of fashionable seminaries, and were drawn to the Lexington school by its fame for body-training. The constant dress of the pupils, like that of the Normal school, was short and loose, leaving the girls as much liberty as boys have in their gymnasium dresses. The results of the physical training at Lexington are well known:—

On entering the school, pupils were measured about the chest, under the arms, about the waist, the arm, and the fore-arm. The average gain for eight months about the chest was 2½ inches; waist, 5 inches; arm, 1½ inches; fore-arm, about 1 inch. The work was so hard that, with all this remarkable development, the weight of the pupil was often lessened. Of course, the girls came with injunctions from their mothers not to climb stairs, and with letters from family physicians urging moderation in gymnastics, and prescribing the horizontal position a number of days each month. With the corsets and long skirts in which they came, these injunctions and cautions were not unwise; but, with the change of dress, became absurd.

And now, with a full knowledge of all the facts familiar to hundreds of grateful parents, the writer affirms that, giving little or no attention to periodicity, the girls worked through the entire month in those extreme stridings and other vigorous exercises of the legs and hips, contrived to counteract the evil effects of the long, imprisoning skirts, and that in the four years not only was no harm done by this constant and dreadful violation of Dr. Edward Clarke's counsels, but that in no instance did a pupil fail to improve in health. The results may be described as follows: Pupils came with dread of stairs, with back-ache, palpitation, and other sufferings which may not be named here, and in a few months could do the full and hard gymnastic work of the school, dance three evenings a week, go upstairs without symptoms, and walk five to ten miles on Saturday without inconvenience. A common exclamation among the pupils was this: "What a slave I was! Everything was toil and suffering. I have now just begun to live!" And all this happy change came of abandonment

* See Knowledge No. 59. † From the *North American Review*.

of corsets, the adoption of a simple, physiological dress, with the exercise which this change in dress renders easy. The change in health and capacity often seemed magical. If this paper were designed for the eyes of medical men only, certain facts might be given which would surprise them, and leave no doubt that we have utterly failed to comprehend the mischief done to the growing form by the present modes of dress.

The reader may think that camp-life in the mountains of California, a course of training in the Normal School for Physical Education, or four years' drill in the school at Lexington, will account for happy changes without any change in dress. We saw many ladies in the mountains seeking health in long skirts and corsets, and their health improved, but the physiologist will assure us that the improvement could not be muscular and radical. As to exercise in the gymnasium, the observation of thirty years in ladies' seminaries leads to the conviction that girls in corsets seriously endanger their welfare when they try to exercise beyond gentle walking and dancing. All attempts at free arm or leg work must prove mischievous. For many years we have cautioned corseted women against the gymnasium, and have seriously urged easy-chairs and lounges. The advice given by Dr. Edward Clarke, and repeated by thousands of doctors to their lady patients, to lie down as much as possible, and periodically spend a week in bed, is, if a corset be worn, not only wise and merciful, but indispensable. To ladies who declare that they cannot abandon their corsets, the writer uniformly gives the same advice.

The errors in women's dress are:—

1. The corset, which reduces the waist from three to fifteen inches, and pushes the organs within, downward.
2. Unequal distribution. While her chest and hips are often overloaded, her arms and legs are so thinly clad that their imperfect circulation compels congestion of the trunk and head.
3. Long, heavy skirts, which drag upon the body, and impede the movements of the legs.
4. Tight shoes, which arrest circulation, and make walking difficult. High heels, which increase the difficulties in walking, and so change the centre of gravity in the body as to produce dislocations in the pelvic viscera.

Lack of space forbids details under each of these heads, so we speak mostly of the corset—by far the greatest evil.

Do women practise tight-lacing? Since beginning this paper, we have asked this question of more than a score of ladies. The answer is "No." One lady, whose waist has been reduced more than eight inches, declares that she has heard about this lacing all her life, but has never seen it. She adds: "I wear a corset, though, from my immense size (nineteen inches), you would hardly think it. And I fancy that ladies generally manage about as I do; they wear a corset to keep their clothes in shape, but it hardly touches them." In forty years' professional experience with the wearers of corsets, we cannot now recall a single confession, even from those who had reduced their waists by from ten to fifteen inches. One can write freely on this subject, with no fear of hurting the feelings of lacing women, for no one of them will imagine herself guilty; and one can speak as disparagingly as he pleases of diminutive figures, for the smallest woman regards herself as "perfectly immense."

We have talked with several corset-makers, and sum up their testimony as follows:—Fashionable ladies, and thousands who imitate them, purchase corsets which are from three to ten inches smaller than their waists, and then lace them so as to reduce their waists from two to eight inches. More than one corset-maker has placed the averages higher than these figures.

Many inquiries have been made of those artists who make a special study of the female figure. Their testimony is stronger than that of the corset-makers. One artist, who is a recognised authority in this department, has assured us that in painting portraits of women, no good artist will paint the laced figure. The subject must hide with drapery what the artist regards as a hideous deformity. An eminent artist, with a good eye and thorough knowledge of proportion in the female figure, permitted the writer to sit by his side on a thoroughfare when ladies were out in force, and expressed his opinion about their waists.

"That one is reduced six inches; that one ten inches; that young lady five; that one twelve; that large woman has reduced her waist fully fifteen inches." "What proportion of these ladies would you paint in their corsets?" he was asked. "I have not seen one that I would paint without asking her to cover her deformity."

If any one will devote an hour to a study of the female figure as seen in classic art, and will then give another hour to street observations during the fashionable promenade, with an aching heart he will go over to the ranks of the discouraged. He cannot forget that these are to be the mothers of our next generation.

A STRANGE CATERPILLAR,

AND ITS REMARKABLE METHOD OF CAPTURING PREY.

By C. F. Holder.

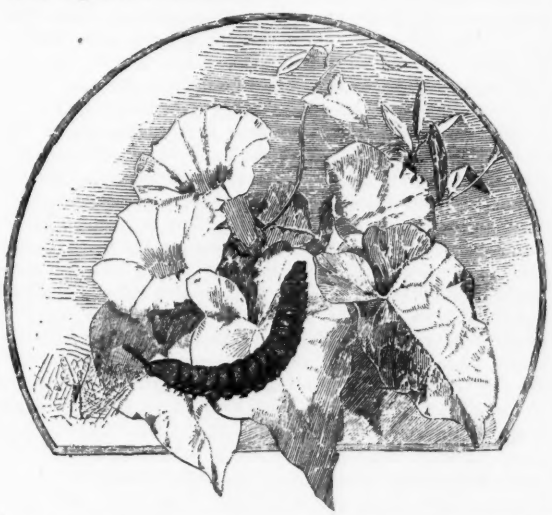
AMONG the many interesting creatures that have been unearthed by scientific investigation during the past few years, the Peripatus deservedly stands foremost in the rank, not alone for its peculiar individuality, but for certain habits shown when obtaining food and defending itself from attack. According to late classification, it forms the single insect of the sub-class Malacopoda, and is only represented by a single genus—Peripatus. It is considered an extremely ancient form, from its wide and peculiar distribution, being found at Cape of Good Hope, St. Thomas, Australia, New Zealand, Chili, and Isthmus of Panama, and thought the nearest extant representative of the ancestors of our air-breathing anthropoda, spiders, &c.

In appearance the *Peripatus capensis* is exceedingly disagreeable, resembling a large black caterpillar, three inches or more in length. From the head protrude a pair of curious jointed horns like antennæ that incline forward, seemingly used as feelers, though the head bears a small pair of simple eyes. Beneath is the mouth, with its singular turned lips and double pair of horny jaws, well adapted for crunching the larger game it affects. The seventeen pairs of feet are short, fleshy, and provided with two short claws adapted for clinging upon rocks or trees. The body is cylindrical and soft, the integument not chitinised, and head not separate from the body, its great difference from other anthropods being in its "two widely separated minutely ganglionated nervous cords sent backward from the brain; also in the minute numerous tracheal twigs arising from the many minute oval openings situated irregularly along the median line of the ventral surface of the body." It calls to mind features of Lingualulina and Tardigrada by its curious soft clawed feet, and, according to Packard, is not a worm, but an intermediate between them and the sucking myriopods. Its method of breathing is peculiar in the extreme. Instead of the tracheal tubes opening to the exterior by small stigmata arranged along the body in regular order, as in other animals that have

tracheæ, their tracheæ are scattered here and there over the entire body. It appears, says Moseley, that we have existing in Peripatus almost the earliest stage in the evolution of tracheæ, and that these air tubes were developed in the first tracheate animal out of skin glands scattered all over the body. In the higher tracheate animals the tracheal openings have become restricted to certain definite positions by the action of natural selection.

The sexes are distinct, and the males much smaller and rarer than the females. Out of fifty specimens found only two were males. The females are viviparous; and, according to the above-mentioned distinguished author, a standard-bearer of the lamented Darwin, a process of development of the young shows that the horny jaws of the animal are the slightly modified claws of a pair of limbs turned inward over the mouth as development proceeds; in fact, "foot jaws," as in other anthropods.

To Moseley is due all the present knowledge concerning this curious insect, and previous to his elaborate examinations at the Cape of Good Hope nothing was known as to its method of breathing air by means of tracheæ, scientists believing it to be an annelid.



In the accompanying cut the great peculiarity of the animal is shown. Being slow, cumbersome, and utterly unable to pursue game, it seems to have been provided by nature with ample compensation. We see it lying upon the ground almost invisible, so similar is it in colour to its surroundings; a fly or some larger insect approaches; the two horns dilate, move to and fro, as if in excitement, and the approaching fly, when within several inches, suddenly stops, as if paralysed and unable to move, but remains suspended in the air. We draw nearer and see the cause of this phenomenon. At the approach of the victim the Peripatus has ejected from its mouth curious thread-like jets of some glutinous irritating fluid that forms instantaneously, as if by magic, a complete network of gleaming, glistening web, that resembles the maze of the spider with its quivering drops of dew. Myriads of these glistening darts or threads encompass the victim, holding it in a close embrace until the unwieldy Peripatus approaches, breaking through the sheeny prison, and releasing the victim to a worse fate.

This remarkable web is found to proceed from large glands that secrete a clear viscid fluid that seems to crystallize when ejected from the papilla, one of which is found at each side of the mouth. If the Peripatus is attacked suddenly the web appears in front of it instantly, the jets forming a perfect protection from many enemies, as it is almost as tenacious as birdlime. It is not an irritant when tasted, but when taken from the glands and placed upon a glass slide, forms a trap for the largest insects, holding them securely.

The food of the Peripatus is, however, to a great extent, vegetable, and in the stomachs of nearly all the specimens examined by Professor Moseley at Good Hope, vegetable matter was found. In their habits they are similar to the common centipedes, living under logs, stones, and dead wood. They are nocturnal insects, moving about in a slow, hesitating manner in the daytime. When at rest the body is perhaps two inches long, but in motion they stretch out in a surprising manner to nearly twice that length. Most of the specimens found by Professor Moseley were in old willows that were highly luminous, and in the weird light the insects were seen coiled up ready for transportation to the collecting case. Professor Moseley thus describes the search for this *rara insecta*:—

"My colleague, the late Von Willemoes Suhm, and I both searched hard for *Peripatus*. He was unsuccessful, but I was lucky enough to find a fine specimen first under an old cart-wheel at Wynberg. Immediately that I opened this one I saw its tracheæ, and the fully-formed young within it. Had my colleague lighted on the specimen, he would, no doubt, have made the discovery instead."

In New Zealand, the species known as *P. Novæ Zealandæ*, is found among the dead wood near Wellington. Here, also, the females predominate. It much resembles the *Capensis*, having, however, thirty feet instead of thirty-four.

Equally remarkable as a web-constructor are the larvæ of a lepidopterous insect, the *Hyphantidium sericarium*, found in Australia. Myriads of the creatures join forces and produce a silken web, in some cases measuring nearly 300 square feet. Mrs. Thos. Wiseman, of Australia, has successfully raised numbers of them, and sent specimens to Europe. Mr. Helenus Scott, of the Wollombi, thus refers to her work in a communication sent to an English naturalist with some specimens:—

"Mrs. Wiseman had placed a quantity of shelled maize in a veranda room, 8 ft. 6 in. long, 6 ft. wide, and 9 ft. 3 in. high, the stone walls being plastered. At a subsequent period, this room being required for a bedroom, the walls were found to be entirely and uniformly covered by a beautiful white-coloured web, fastened at the ceiling, floor, and corners by a stouter and coarser fabric, and occasionally to portions of the wall itself; so that in this instance an unbroken sheet of cloth, containing some 72 square feet, might with care have been obtained; while the web measured at least some 252 square feet. The specimens of this cloth sent to me, rudely torn from the walls, were of the size of a large handkerchief. The remaining portions of the original construction had been ruthlessly destroyed by the servants. The larva, when full-grown, is about five-twelfths of an inch in length, with the head and first annulation depressed, somewhat horny, and of a blackish-brown. It possesses sixteen feet.

"It is of a pale yellowish-white colour, with whorls of six small black spots on each annulation, each emitting a tiny hair. The caudal segment is spotted with brown.

"In confinement these caterpillars were found to be active, with a dislike to the light; so that when exposed, they immediately commenced spinning their web, connecting together several grains of the maize, upon which they subsisted. They likewise lined the top and sides of the box with their silken tissue.

"At the latter end of August they assumed the pupa state, each larva assuming a separate cocoon for itself

among the maize, consisting of a flimsy web somewhat tightly enveloping the chrysalis, which was of a light yellowish-brown, with the wing-cases largely developed and one-third of an inch in length.

"The perfect insect took wing in October, and is three-fourths of an inch in expanse, and active in its movements. The superior wings were elongated, the costal margin arched, the apices rounded. General colour greyish-brown, of a silvery hue, with stigmata and strigæ of a darker colour. Inferior wings of a light semi-transparent silvery hue, with a deep marginal fringe. Thorax similar in colour to the anterior wings, and not crested. Abdomen yellowish; the whole of the under side light silvery grey. The wings are slightly convoluted in repose."—*Scientific American.*

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

No. II.—JOINTS.

By Dr. Andrew Wilson, F.R.S.E.

THE name "joint" is given to the movable surfaces between two or more bones; and, as a matter of fact, muscular movements (to be discussed in another paper) are directed towards the movements of the bones concerned in forming the joint. The scientific name of a joint is an *articulation;* and the reason for the application of this name, at once to the connected series of syllables and words which form "speech," and to bodily mechanics, can be readily appreciated. There are some five structures which enter into the formation of an ordinary "joint." Firstly come the *bones.* Then, secondly, bones are tied together by stout fibrous cords, known as *ligaments.* The beautiful ligaments of the knee, uniting the thigh to the top of the shin-bone, or those of the elbow joint, illustrate the cords in question. Ligaments are related to the sinews (or tendons) of muscles in their composition; both being fibrous cords. Thirdly comes the layer of gristle or *cartilage* which coats the ends of the bones which rub on one another in the movements of the joint. This cartilage is called *articular cartilage.* It is of a beautifully smooth, glistening structure (as may be seen in a butcher's shop, when we inspect the end of a bone which has just been turned out of its socket), and is of a bluish-white colour. This cartilage acts the part of a "buffer," and serves to limit jarring and concussion in joints, besides rendering the movements of the bones smooth. The fourth structure found in a joint is a peculiar membrane or layer, which receives the name of *synovial membrane,* and which, practically, lines the cavity of the joint. The office of this membrane is to manufacture a glairy fluid named *synovia,* which serves as "joint-oil," and which, being poured out between the movable surfaces, lubricates the bones in their movements. When, through inflammation of the joint, the synovial fluid increases in extent, we suffer from what is popularly called "dropsy" of the joint. The fifth set of structures which may be found associated with joints are known as *bursæ.* These are little cushions or pads, covered usually with synovial membrane, and placed in situations where there is liability to friction. The *bursæ* are to the body, in fact, what the grooved wheel inside the sailor's "block" is to the tackle of a ship: they diminish friction. We discover them in situations where, for example, there is a great play of muscle or sinew over any surface. Between the skin and the knee-cap, for example, where, it is evident, much friction must exist, a *bursæ* is interposed. Another exists between the great projection near the head of the thigh-bone and the hip-muscles which rub over the projection at every step we take.

Such being the general conformation of "joints," we may now survey the various forms of articulations met with in our frames. There are three classes of joints to be found in the bodies of man and his neighbour animals. Firstly come what seem to imply a contradiction in terms, namely, *immovable joints.* These are well represented in the dove-tailing which is seen between the bones of the skull, a process securing immense firmness of union. The next variety of joints includes those which are named *mixed* articulations. Here we find only a limited range of movement, which may, as in the spine, confer general flexibility, rather than exact movement, upon the parts concerned. In the spine, for example, we have a series of bones, firmly united together (for the protection of the *spinal cord*) by intervening plates of gristle or cartilage. The alternating series of bone and gristle-pads thus seen confers a high degree of flexibility on the spine, without permitting any definite range of motion between the separate bones.

But the most typical joints are those in which free movement in one direction or another is permitted. Under this head—that of *movable joints*—come the ordinary joints of the body: elbow, shoulder, ankle, knee, fingers, toes, &c. It is very obvious to any one who swings his arm round and round at the shoulder, that the movement there is of a different nature from that seen in the knee or elbow; whilst the familiar "turn of the wrist" again represents a movement of a third kind. Thus it becomes clear that we find in the mechanics of our bodies—firstly, *ball-and-socket,* or "universal" joints, capable of free movement in all directions. The deeper the cup, or socket, the more limited is the movement. Witness, in proof of this fact, the more limited movement of the hip joint (where the cup is deep) compared with that at the shoulder, where the cup is a mere shallow "saucer" of the shoulder-blade. At the elbow, knee, ankle, and in the fingers and toes, *hinge-joints* are represented. The motion is backwards and forwards in these joints; but such a joint as the knee performs more complex movements than are included under this description. Lastly come the *rotatory joints* in which the movement takes place round a fixed point or *pivot.* When, after keeping the fore-arm fixed with the palm of the hand turned forwards, we suddenly reverse the palm and turn it backwards, one of the bones (*radius*) of the forearm runs (or rotates) round the other bone (*ulna*) of the forearm, and so reverses the position of the hand. The radius thus comes to cross the ulna, as when a speaker, addressing an audience, places both palms downwards on a table in front of him, in the familiar style. Here there is seen the round head of the radius rotating round the ulna, its neighbour-bone; and it may be added that there are certain animals (*e.g.*, elephants and dogs, cats, and carnivora generally) in which the radius is permanently fixed in the crossed position, known scientifically as *pronation.* The position in which the two bones lie side by side (as when the palm is directed forwards) is called *serpination.* When we turn our head on our neck we receive a second illustration of a "pivot-joint." Then the head, together with the first vertebra of the spine, or "atlas," move a little around a little bony peg borne on the second vertebra or *axis.*

It may be added that in the use of the various "joints," highly instructive examples of "animal mechanics" may be occasionally found. Thus the bones really constitute a series of levers of various kinds. When we pull the head backwards on the neck, we are using a lever of the first order. Here the *weight* (the face) is on one side of the

fulcrum (the neck), and the *power* (the muscles of the back of the neck) is situated on the opposite side of the fulcrum from the weight. Again, if we stand on tip-toe, we use a lever of the second order. Here, the *weight* (*i.e.*, the body or leg) is situated between the *power* (the calf-muscles) and the *fulcrum* (the toes). Or when we raise our hand to our mouth in the act of eating, or of feeding ourselves, when the shoulder is fixed, we use a lever of the third order. For in the latter case, the *weight* (the hand and its contents) is placed at one extremity, the *fulcrum* (the *elbow*) at the other, whilst the *power* (the biceps muscle) acts between the weight and the fulcrum.

LEARNING LANGUAGES.

(*Continued from page 465.*)

HAMILTON'S METHOD.

WE have been asked by several correspondents to quote what Sydney Smith has said on the Hamiltonian method, before giving our own experience with it. His essay (written fifty-six years ago) is too long to be given in full; but the following passages will meet our readers' wishes:—

"One of the first principles of Mr. Hamilton is to introduce very strict literal, interlinear translations, as aids to lexicons and dictionaries, and to make so much use of them that the dictionary or lexicon will be for a long time little required. We will suppose the language to be the Italian, and the book selected to be the Gospel of St. John. Of this Gospel Mr. Hamilton has published a key, of which the following is an extract:—

'1. Nel principio era il Verbo, e il Verbo era
In the beginning was the Word, and the Word was
appresso Dio, e il Verbo era Dio.
near to God, and the Word was God.

'2. Questo era nel principio appresso Dio.
This was in the beginning near to God.

'3. Per mezzo di lui tutte le cose furon fatte: e
By means of him all the things were made: and
senza di lui nulla fu fatto di ciò, che è stata
without of him nothing was made of that, of which is been
fatto.
made.

'4. In lui era la vita, e la vita era la luce degli
In him was the life, and the life was the light of the
uomini:
men:

'5. E la luce splende tra le tenebre, e le
And the light shines among the darkness, and the
tenebre hanno non ammessa la.
darknesses have not admitted her.

'6. Vi fu un uomo mandato da Dio che nomava
There was a man sent by God who did name
si Giovanni.
himself John.

'7. Questi venne qual testimone, affin di rendere
This came like as witness, in order of to render
testimonianza alla luce, onde per mezza di lui tutti
testimony to the light, whence by mean of him all
credessero.'
might believe.'

"In this way Mr. Hamilton contends (and appears to us to contend justly), that the language may be acquired with much greater ease and despatch than by the ancient method of beginning with grammar and proceeding with the dictionary. We will presume at present, that the only object is to read, not to write or speak Italian, and that the pupil instructs himself from the Key without a master, and is not taught in a class. We wish to compare the plan of finding the English word in such a literal translation, to that of finding it in dictionaries—and the method of ending with grammar, or of taking the grammar at an advanced period of knowledge in the language, rather than at the beginning. Every one will admit, that of all the disgusting labours of life, the labour of lexicon and dictionary is the most intolerable. Nor is there a greater object of compassion than a fine boy, full of animal spirits, set down in a bright sunny day, with a heap of unknown words before him to be turned into English, before supper, by the help of a ponderous dictionary alone. The object in looking into a dictionary can only be to exchange an unknown sound for one that is known. Now, it seems indisputable, that the sooner this exchange is made the better. The greater the number of such exchanges which can be made in a given time, the greater is the progress, the more abundant the *copia verborum* obtained by the scholar. Would it not be of advantage if the dictionary at once opened at the required page, and if a self-moving index at once pointed to the requisite word? Is any advantage gained to the world by the time employed first in finding the letter P, and then in finding the three guiding letters P R I? This appears to us to be pure loss of time, justifiable only if it be inevitable; and even after this is done, what an infinite multitude of difficulties are heaped at once upon the wretched beginner! Instead of being reserved for his greater skill and maturity in the language, he must employ himself in discovering in which of many senses which his dictionary presents, the word is to be used; in considering the case of the substantive, and the syntaxical arrangement in which it is to be placed, and the relation it bears to other words. The loss of time in the merely mechanical part of the old plan is immense. We doubt very much if an average boy, between ten and fourteen, will look out or find more than sixty words in an hour; we say nothing at present of the time employed in thinking of the meaning of each word when he has found it, but of the mere naked discovery of the word in the lexicon or dictionary. It must be rembered, we say an *average* boy—not what Master Evans, the show boy, can do, nor what Master Macarthy, the boy who is whipt every day, can do, but some boy between Macarthy and Evans; and not what this medium boy can do, while his mastigophorous superior is frowning over him, but what he actually does, when left in the midst of noisy boys, and with a recollection that, by sending to the neighbouring shop, he can obtain any quantity of unripe gooseberries upon credit. Now, if this statement be true, and if there are 10,000 words in the Gospel of St. John, here are 160 hours employed in the mere digital process of turning over leaves! But, in much less time than this, any boy of average quickness might learn, by the Hamiltonian method, to construe the whole four Gospels, with the greatest accuracy, and the most scrupulous correctness. The interlineal translation of course spares the trouble and time of this mechanical labour. Immediately under the Italian word is placed the English word. The unknown sound therefore is *instantly* exchanged for one that is known. The labour here spared is of the most irksome nature; and it is spared at a time of life the most averse to such labour; and so painful is this labour to many boys, that it forms an insuperable

obstacle to their progress. They prefer to be flogged, or to be sent to sea. It is useless to say of any medicine that it is valuable, if it is so nauseous that the patient flings it away. You must give me, not the best medicine you have in your shop, but the best you can get me to take."

Our author then illustrates the dictionary method; but he wrote at a time when as yet even the idiocy of supplying boys with only Greek-Latin lexicons had not been corrected. We omit the passage, though instructively showing to what lengths educational absurdities may go; and also that they are not quite hopelessly long-lived. Sydney Smith speaks of this particular case as an "afflicting piece of absurdity."

"The recurrence to a translation is treated in our schools as a species of imbecility and meanness; just as if there was any other dignity here than utility, any other object in learning languages than to turn something you do not understand into something you do understand, and as if that was not the best method which effected this object in the shortest and simplest manner.

"If a boy were in Paris, would he learn the language better by shutting himself up to read French books with a dictionary, or by conversing freely with all whom he met? And what is conversation but an Hamiltonian school? Every man you meet is a living lexicon and grammar—who is perpetually changing your English into French, and perpetually instructing you, in spite of yourself, in the terminations of French substantives and verbs. The analogy is still closer, if you converse with persons of whom you can ask questions, and who will be at the trouble of correcting you. What madness would it be to run away from these pleasing facilities, as too dangerously easy—to stop your ears, to double-lock the door, and to look out *chickens; taking a walk;* and *fine weather*, in 'Boyer's Dictionary'—and then, by the help of Chambaud's Grammar,' to construct a sentence which should signify, '*Come to my house and eat some chickens, if it is fine!*'

"But what is to become of a boy who has no difficulties to grapple with? How enervated will that understanding be to which everything is made so clear, plain, and easy!—no hills to walk up, no chasms to step over; everything graduated, soft, and smooth. All this, however, is an objection to the multiplication table, to Napier's bones, and to every invention for the abridgment of human labour. There is no dread of any lack of difficulties. Abridge intellectual labour by any process you please—multiply mechanical powers to any extent—there will be sufficient, and infinitely more than sufficient, of laborious occupation for the mind and body of man. Why is the boy to be idle? By-and-by comes the book without a key; by-and-by comes the lexicon. They do come at last—though at a better period. But if they did not come—if they were useless, if language could be attained without them—would any human being wish to retain difficulties for their own sake, which led to nothing useful, and by the annihilation of which our faculties were left to be exercised by difficulties which *do* lead to something useful—by mathematics, natural philosophy, and every branch of useful knowledge? Can any be so anserous as to suppose that the faculties of young men cannot be exercised, and their industry and activity called into proper action, because Mr. Hamilton teaches, in three or four years, what has (in a more vicious system) demanded seven or eight? Besides, even in the Hamiltonian method it is very easy for one boy to outstrip another. Why may not a clever and ambitious boy employ three hours upon his key by himself, while another boy has only employed one? There is plenty of corn to thrash, and of chaff to be winnowed away, in Mr. Hamilton's system; the difference is, that every blow tells, because it is properly directed. In the old way half their force was lost in air. There is a mighty foolish apophthegm of Dr. Bell's, that it is not what is done for a boy that is of importance, but what a boy does for himself. This is just as wise as to say that it is not the breeches which are made for a boy that can cover his nakedness, but the breeches he makes for himself. All this entirely depends upon a comparison of the time saved, by showing the boy how to do a thing, rather than by leaving him to do it for himself. Let the object be, for example, to make a pair of shoes. The boy will effect this object much better if you show him how to make the shoes, than if you merely give him wax, thread, and leather, and leave him to find out all the ingenious abridgments of labour which have been discovered by experience. The object is to turn Latin into English. The scholar will do it much better and sooner if the word is found for him, than if he finds it—much better and sooner if you point out the effect of the terminations, and the nature of the Syntax, than if you leave him to detect them for himself. The thing *is* at last done *by the pupil himself*—for he reads the language—which was the thing to be done. All the help he has received has only enabled him to make a more economical use of his time, and to gain his end sooner. Never be afraid of wanting difficulties for your pupils; if means are rendered more easy, more will be expected. The animal will be compelled or induced to do all that he can do. Macadam has made the roads better. Dr. Bell would have predicted that the horses would get too fat; but the actual result is, that they are compelled to go ten miles an hour instead of eight."

The Edison electric light has been exhibited in Australia, under the auspices of Major Flood Page, late manager of the Sydenham Crystal Palace. The light is exceedingly well spoken of.

Professor Marsh has unearthed some extraordinary fossil remains in America, but his discoveries only whet the appetite for more. Here is one reported from Paris, Kentucky, which gives an account of the discovery of the bones of a mastodon which must have been a veritable monster. The backbone, measuring from the head to the bones of the tail, was 40 ft. in length, and the hind quarters stood over 23 ft. in height. The head must have been 5 ft. in width, and the jaw is 12 in. thick, with teeth in good preservation, weighing between 2 lb. and 3 lb. each. The remains are said to be all in good condition, and they are rightly described as the most astounding discovery in the way of fossil remains with which America has yet presented us.

Consumption of Watch Glasses.—According to the *Revue Chronométrique*, there are annually manufactured 2,500,000 watches, and during the last fifty years more than 70,000,000 have been put on the market; there remains yet for us to add a stock of not less than 50,000,000 of old watches, which makes a total of 86,000,000 to 87,000,000 watches requiring glasses. The new watches consume nearly 4,000,000, which makes an annual consumption of not less than 47,000,000 of glasses. But we must add that every watchmaker away from a town sees the necessity of always having on hand an assortment responding to the wants of his customers. "Then, if we take into account children's watches, lockets, compasses, &c., one finds one's self with astonishment in the face of an annual consumption which cannot be less than 100,000,000 of glasses."

"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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No communications are answered by post, even though stamped and directed envelope be enclosed.

BRITISH SNAKES.

[668]—The three British snakes are the Viper, Ringed Snake, and the Smooth Snake, (*coronella lævis*). The Smooth Snake is as local in England as on the Continent—indeed, I do not recollect any records of its occurrence hitherto, except in Hants and Dorset.

It becomes tame in confinement, and though it may sometimes try to use its teeth, it belongs to a perfectly harmless genus. The plate in Cook's "Reptiles" conveys a fair idea of the Smooth Snake, but living examples can often be examined at the Reptile House of the Zoological Society, on application to the keeper. The Smooth Snake subsists mainly on lizards. H. A. M.

COLD BATH AT NIGHT.

[669]—In reference to A. E. Oram's query (605, page 364) as to the healthfulness of a cold bath at night, I should be inclined to say that—as a practice—it is not healthy. After a hard day's work, when the muscles are wearied or the nerves strained, a *warm bath* is undoubtedly very comforting, and is also in a sense beneficial, as it produces a relaxation of the stiffened muscles. A *cold bath*, on the other hand, has an astringent effect, and must necessarily cause further contraction of the muscles. (In plethoric persons there would also be a risk of congestion of the lungs or brain.) For my own part, I decidedly object to the idea of a cold bath at night after a hard day's work.

This opinion is, of course, one on the general question merely.

Robert Macpherson, M.D.

SINGULAR RAINBOW.

[670]—In letter 637, Knowledge, Nov. 24, the writer evidently does not grasp the whole problem. In a communication sent to the Physical Society, London, Nov. 10, and read Nov. 25 (a copy of which I have forwarded to you), I have shown (1) that for the observer to see a complete non-concentric bow he must be surrounded by water, and also what parts of the bow he sees if the reflecting sheet of water be only behind, before, or to one side of him; (2) that the non-concentric bow is inclined to the reflecting plane at an angle equal to the angle of incidence of the light falling on this same plane; (3) that the non-concentric bow has been seen only when the sun has been at a low altitude, on account of there being at such times a maximum of light reflected and a minimum of loss from polarisation; and (4) that at such an angle as that given in the second figure (letter 637), Knowledge, p. 422, it would be impossible to see a complete non-concentric bow on account of polarisation. William Ackroyd.

HOVERING INSECT HOUSE-FLIES.

[671]—No one has answered Mr. Wynne's note, No. 616, so the following information may be useful:—I never heard of such an insect as an ichneumon wasp; they (the ichneumons and the wasps) are two distinct families of the order Hymenoptera, and do not hover as he describes. The insect he has observed is without doubt a dipterous fly of the family "Syrphidæ," either "Eristalis" or "Syrphus," probably the common "Eristalis tenax." They are often called "hoverers" from their peculiar flight. As regards the number of vibrations of the wings, I can give him no information, but Latour has calculated those of a common gnat at 3,000 a minute (Kirby & Spence, p. 59).

In answer to M. D. (No. 633), I am afraid he is very much mistaken in stating that bluebottles are developed within the body of the female fly in a maggot state. All flies are produced from eggs laid in or on the substance upon which the maggots afterwards feed, and they breed so rapidly that a very few specimens of hybernated impregnated females who lay their eggs in the spring will produce the numbers he sees every year. The same holds good with a number of other insects, notably wasps and bumble-bees, who may be seen on the move, and looking out for a suitable place for their nests on a fine spring morning. Destroying them at that time means destroying a whole nest; and if then hunted and killed, will make a distinct diminution in the number of nests in the immediate neighbourhood.

Réaumur has proved that in five generations an aphis can be the progenitor of 5,904,900,000 descendants, and that there can be twenty generations in one year (Kirby, p. 96). The flies dont go on quite at this rate, but they are what the Yankees call "pretty smart." As to their disappearance in the autumn, I think the spiders and the frosts quite account for that.

An Old M. E. S.

ISLANDS IN PACIFIC OCEAN AND RATS.

[672]—My experience has been quite opposed to the statement made in Knowledge of 17th ult. on the above subject.

I lived for about a year on the largest island of a small group called Labos de Afuera (important chiefly on account of the deposits of guano on them), situated in about 7° south latitude, and fifty or sixty miles from the Peruvian coast.

I occupied a portion of a large modern house, which, I might say, was infested with rats. I have been repeatedly wakened at night by the rasping noise they made in their endeavours to force their way into my bedroom. Sometimes two would be simultaneously at work—one near the bottom of the wall, or partition, the other near the ceiling. Where an entrance was effected, I used to get up, and, arming myself with a stick, give the intruders chase.

They were a great nuisance, and I would have been heartily glad if they had all been carried off by a *rapid* consumption. Two cats which we had (first-rate ratters) used to reduce their numbers considerably, but they still continued to increase. On one occasion I found a nest under a water-butt, containing, if I remember rightly, ten little rats.

Nothing in the shape of eatables was safe from these vermin; they even attacked our live-stock, such as pigeons and chickens.

J. H. M. Fallon.

ALTERATION IN COAST LINE.

[673]—I thought it very interesting to observe how the sea has receded along the coast of Lancashire from the Mersey almost to Preston. The whole country for miles is as flat as the proverbial pancake, and it can at once be seen that all this land, which is entirely made up of sand, must have been gradually formed by the retrocession of the sea.

At Southport, at low tide, the water goes out for at least two miles, the head of the pier, which is nearly a mile long, being just kept free of sand by a channel which runs by it. The tide seems to ebb almost at once for a considerable distance out, and the time cannot be very remote when Southport will be an inland town.

Are there any data showing the rate the water is receding along the Lancashire coast? H'sett.

Oct. 17, 1882.

Answers to Correspondents.

Readers. Glad to find you among readers, whether you hail from Giggleswick, Cambridge, Rugby, or Clifton. I fear you have given some time to logic. No offence: so have I; and I wish the time had been better bestowed. But the four you name were teachers, not students only. Besides, their reasoning powers would have stood a good deal of impairing. Yet can you name any useful product of their logic? Note, further, that it was one of those very four who said that certain false reasoning would mislead students of logic, though its falsity is obvious to persons of ordinary reasoning powers. You write rather snappishly. Perhaps it misled you. Well, well! But you should not be angry with *me*.

Here is a little syllogism to comfort you:—Major premiss, Every anonymous correspondent is to be mistrusted; minor premiss, This correspondent is anonymous; conclusion, I will betake me to the next.—C. R. T. No; Newcomb's account of the tides is incorrect; he has himself admitted as much. I have written nothing on the subject myself. I know of no better discussion of the tides than that presented in Sir Edward Beckett's "Astronomy without Mathematics."—W. Cave Thomas. I owe you a thousand apologies. How the word "Delight" for "Light" in first line of your remarks on the Libration of Sensation escaped my notice—once and again—I cannot imagine. It looks like an elaborate joke. Your theory is certainly worthy of much attention, as affording a satisfactory explanation of the ocular spectra. —A correspondent calls attention to the wave described on page 435, as "shaped somewhat like a cone." He was in Carmarthen at the time and heard of no such wave, nor can he imagine such a wave. It was so described in a letter to a daily paper at the time, and was seen of many. The account manifestly means a round-top wave diminishing in height on either side of its highest part, somewhat like the half of two equal cones, connected by their bases, and divided by a horizontal plane through their horizontal common axis. The description is inexact, of course, but in such cases it is better to use the words actually given. The same correspondent finds (1) most of the buds in his garden have a distinctive colour, rather pinkish, and (2) notes that scales must be of a strange non-conducting material to prevent the bud from acquiring the temperature of the atmosphere in the course of a night. But it is a question of radiation, not of conduction. Wells smiled when his gardener spoke of a mat on sticks keeping plants under them warm; but Wells found the gardener was right, while he, "in the pride of half-knowledge" (his own words, for he was one of the manly sort), had been mistaken.—E. J. McN. (1) Distance of Betelgeux, Rigel, and Procyon not determined. (2) Have no doubt myself stars in the trapezium connected with nebula. (3) Mars now in constellation Sagittarius. (4) A good bargain. (5) Only the two outermost, I think.—Dewi G. Please send order to publishers.—Dullard. (1) Sulphide of sodium is said so to act. (2) Do not think Lord Raleigh said that. As a matter of fact it is not true that a T chimney-pot uniformly cures smoking,—depends which way wind is.—A Student explains that if a plane figure is subject to one condition (as that a certain curve must always touch a fixed curve) it has two degrees of freedom; when it is subject to two conditions, it has one degree of freedom left, and can only move in a certain definite manner (2) Know very little about determinants, having never wanted them. (3) My case, as you say, wears a gloomy aspect, as he would judge it. Albeit the general case is hopeful. As knowledge advances, "the fiend of intolerance" has to retreat.—Zuschaur. I cannot think myself apt at learning languages when I consider what others have done. True, I could talk French at seven or eight; but would not any child thrown among French children at that age learn to talk the language? German I only learned to read by the Hamiltonian method. Being in earnest, I learned the declensions, conjugations, &c., *afterwards*.—E. C. Hooton, E. R. Hodges. Many thanks. Congratulate you on seeing transit so well. I saw nothing of it at Edinburgh, where I was.—Faciebat. Yes, it should have been bisulphide of iron, the primary form of which is cubic; it streaks dark brown. Overlooked the error.—Photo Glasgow. Do not know enough about mesmerism to say.—T. S. L. wants to know what is the standard catalogue of butterflies and moths.—W. H. Jones. Believe so. Column will soon be closed. W. Howard. Thanks.—T. R. Clapham. Dawes and others, who have seen similar flights, have on changing focus found the small bodies to be insects in swarms.—D. Q. J. The letters F.R.A.S. mean only that some one who takes enough interest in astronomy to wish to join the Astronomical Society, has been nominated by a sufficient number of friends already members of the society, has been elected, and has paid his fees. But there is no society which requires special qualifications to be in any way tested. —Jack Stay. (1) One cannot speak of "the horizontal parallax of a body when viewed from two points of observation." The horizontal parallax of a heavenly body is the angle between a line drawn to that body when on the horizon, and a line to the body from the earth's centre. Practically, for a body so far off as the sun, it means the angle having earth's radius as arc and sun's distance as radius. (2) Body weighs more at pole than at equator; partly because nearer centre, and partly because there is no centrifugal tendency at the pole. Proximity counts for something. In fact, a body at the equator would weigh 1-599th less than a body at the pole, if earth were not rotating; but really weighs 1-195th less—the difference 1-289th being what is due to centrifugal tendency. (3) Am writing a popular astronomy; but how soon it will be finished cannot say.—A. R. Molison. The explanation is ingenious; but the crescent is in the first place too narrow, and in the second, it is black compared with solar disc—having, if of lightness of full moon—only about 1-620,000th of the brightness of the sun.—A. F. Osborne. Next total eclipse visible in England in 2090, last on May 22, 1724; band of total phase just outside London on the north-west.—T. A. B. Glad my experience corroborates yours. But I could quote multitudinous evidence. On the other point, I have very little doubt you are right, though how many are so unwise it would be difficult to say. Possibly many. As Herbert Spencer well says, the average man cannot at all shake off those absurd notions, even the exceptional man only imperfectly. I suppose I must be extra-exceptional; for, since I was a lad at college, most of them have been simply non-existent with me, and the rest have gone the same way, making room for worthier thoughts. Still, such nonsense is not even worth ridiculing, unless unwisely obtruded on notice.—W. Marshall. Queries noted; in electrical and chemical column may be replied to.—A. P. Holden. Frankly, I dread the flood of sun-spot and anti-sun spot letters, articles, cuttings, &c., which the publication of your letter would bring upon us. If I note that the case for auroras seems to me fully made out (long since), and variation of temperature also, as Sir W. Herschel anticipated, I have admitted all that has been proved. I think I have read very nearly all that has been said for and against; and I must say it seems to me marvellous how little evidence will suffice with some to establish a cycle of rain, storm, famines, &c. Perhaps a hundred years hence there will be evidence ranging over a long enough period to exclude such chance coincidences as cannot but be observed in these matters.—W. Adams. The secretary who "does" my autographs is from home just now.—Dr. E. H. R. Many thanks; but literally no available space.—Corsettée. (1) Unquestionably excessive. It would be nearer the mark to say that by constant lacing the abdominal and lumbar envelopes become so relaxed and flaccid that when the pressure is removed they yield seven or eight inches. (2) On the authority of all medical men, save perhaps one or two, sleeping in tight corsets is very bad indeed for the health. (3) There are doctors who have stated that at least one-third of the ailments of married women are caused by tight lacing—not by wearing corsets, for whatever some caustic writers may assert, a great number of those women who say they do not lace tightly, tell the truth; as is shown (according to medical testimony) by the shapeliness of the figure when the corset is removed. The tight lacers are known (I speak always of medical testimony) by having no shapeliness at all.—W. R. The temperature of space, if space is practically void of matter, would be near the absolute zero of temperature, or 458° Fahr. below zero, or 490° Fahr. below the freezing point of water, if Clerk Maxwell and Clausius are right in their views about the absolute zero.—H. S. Do not know what clergyman you refer to as having invented an instrument for testing the magnifying power of a telescopic eye-piece.—W. M. Gahan. Many thanks for cutting and pamphlet respecting hurricane.

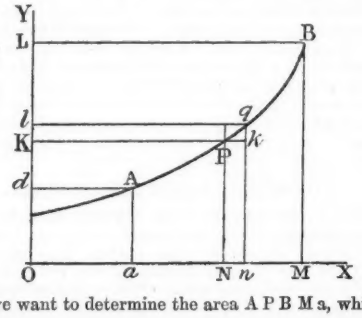
Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

[Note.—These papers were commenced in No. 35, p. 83, vol. II., and continued in Nos. 36–42, 44, 46, 49, 50, 52, 54, and 57–59.]

No. XVI.—Integration by Substitution.

It is sometimes found that an expression which cannot be integrated as it stands, may be integrated by changing the variable. The best way of making clear the rules for doing this will be by considering a simple geometrical example.



Suppose we want to determine the area A P B M a, which, as we

have seen, is represented by $\int_a^b y\,dx$

(Suppositions the same as before.) Then drawing A d, B L, perpendicular to O Y, we might find it convenient to regard y as the dependent variable, passing from O d to O L, instead of taking x from O a to O M. As before, we should get for our element of area P n; where N n is Δx, a small increment of x. We can, however, as readily use l K, or Δy, the corresponding increment of y. For we have

$$\text{N n} = \text{P k} = \frac{\text{P k}}{\text{q k}} \cdot \text{q k} = \frac{\Delta x}{\Delta y} \cdot \Delta y.$$

That is

$$\text{rect P n} = \text{P N} \cdot \text{P k} = y \frac{\Delta x}{\Delta y} \cdot \Delta y;$$

or ultimately when Δx, Δy are made indefinitely small,

$$\text{P n} = y \frac{dx}{dy} \cdot dy$$

and taking y from O d ($= a_1$ suppose) to O L ($= b_1$ suppose) we have

$$\text{area A B M a} = \int_{a_1}^{b_1} y \frac{dx}{dy} \cdot dy.$$

In any such case where we have to integrate between $x = a$ and $x = b$, the expression $\int u dx$, where u is some fraction of x, we may regard x as a function of some new variable y, if only by changing y between certain limits a_1 and b_1 we get all the values of u which it would receive when we changed x between a and b. We have then

$$u dx = u \frac{dx}{dy} \cdot dy \text{ and } \int_a^b u dx = \int_{a_1}^{b_1} u \frac{dx}{dy} \cdot dy$$

and the work of integration is reduced to that of integrating the indefinite integral $\int u \frac{dx}{dy} \cdot dy$.

Suppose, for example, we had to integrate

$$\int \frac{dx}{x\sqrt{x^2 - a^2}}$$

Let us try the experiment of putting $x = \frac{1}{y}$.

Then $\frac{dx}{dy} = -\frac{1}{y^2}$ and $\int \frac{dx}{x\sqrt{x^2 - a^2}} = \int \frac{y^2}{\sqrt{1 - a^2 y^2}} \left(-\frac{1}{y^2}\right) dy$

$$= -\int \frac{dy}{\sqrt{1 - a^2 y^2}} = -\frac{1}{a} \int \frac{dy}{\sqrt{\frac{1}{a^2} - y^2}} = -\frac{1}{a} \sin^{-1} ay = -\frac{1}{a} \sin^{-1} \frac{a}{x}$$

Again, take $\int \frac{dx}{x\sqrt{2ax - a^2}}$. Here noting that the denominator may be written $x\sqrt{x^2 - (x-a)^2}$, we are led to try putting $\frac{x-a}{x} = z$, which will obviously simplify the radical.

This gives $1 - \frac{a}{x} = z$, or $x = \frac{a}{1-z}$; $\frac{dx}{dz} = \frac{a}{(1-z)^2} = \frac{x^2}{a}$;

and $\frac{x^2 - (x-a)^2}{x^2} = 1 - z^2$, *i.e.*, $\sqrt{2ax - x^2} = x\sqrt{1 - z^2}$;

$$\therefore \int \frac{dx}{x\sqrt{2ax - x^2}} = \int \frac{1}{x^2 \sqrt{1 - z^2}} \frac{dx}{dz} \cdot dz = \frac{1}{a} \int \frac{dz}{\sqrt{1 - z^2}}$$

$$= \frac{1}{a} \sin^{-1} z = \frac{1}{a} \sin^{-1} \frac{x-a}{x}$$

This method of integration by parts is usually tentative,—several substitutions may be tried before one is hit upon which gives an integrable expression.

Integration by Parts.

Another method (also tentative) is available, when we are endeavouring to integrate an expression.

Supposing we had to obtain the area A B M a. We might in some cases find it more convenient to determine instead the area A B L d, which gives us what we are seeking, because

$$\text{area A B M a} = \text{rect L M} - \text{rect d a} - \text{area A B L d}.$$

If we regard O N, P N (or P K, P N), the ordinates of P, as functions x and y of some third variable t, then we have

$$\text{rect K N} = xy = u, \text{ say},$$

and if we increase t by Δt so that x becomes O n or $x + \Delta x$, and y becomes O l or $y + \Delta y$. We have

$$\text{increase of rect K N} = \text{rect P n} + \text{rect l P (ultimately)};$$

$$\text{that is, } \Delta(xy) = y\Delta x + x\Delta y$$

$$= y \frac{\Delta x}{\Delta t} \Delta t + x \frac{\Delta y}{\Delta t} \Delta t$$

whence, making Δt indefinitely small

$$\frac{d(xy)}{dt} = y \frac{dx}{dt} + x \frac{dy}{dt}$$

or

$$xy = \int y \frac{dx}{dt} dt + \int x \frac{dy}{dt} dt$$

wherefore

$$\int x \frac{dy}{dt} dt = xy - \int y \frac{dx}{dt} dt$$

(This really corresponds only to saying that in passing from P to B, the increment of rect K N, namely the gnomon L P M, is equal to the sum of the increments of the areas A P N a and A P K d). Thus if an integral can be written in the form $\int x \frac{dy}{dt} dt$, where x and y are both functions of t, we may substitute for the integral so written

$$xy - \int y \frac{dx}{dt} dt$$

This is equivalent to finding the area A B L d, instead of the area A B M a.

As an example consider the integral

$$\int \log x\, dx$$

This may be written

$$\int \frac{dx}{dx} \cdot \log x\, dx$$

Hence by the formula just obtained we have

$$\int \log x\, dx = x \log x - \int x \cdot \frac{1}{x} dx$$

$$= x \log x - x$$

Our Chess Column.

By Mephisto.

THE following lively game was played by Mephisto against an amateur :—

EVANS GAMBIT.

White. Mephisto.	Black. Amateur.	White. Mephisto.	Black. Amateur.
1. P to K4	P to K4	13. Kt tks P (ch)	K to K sq. (*g*)
2. Kt to KB3	Kt to QB3	14. R to K sq. (*h*)	B to K3
3. B to B4	B to B4	15. P to Q5	Kt takes P (*i*)
4. P to QKt4	B takes P	16. Q to R5 (ch) (*j*)	P to Kt3
5. P to B3	B to B4 (*a*)	17. Kt takes P	Kt to B3 (*k*)
6. P to Q4	P takes P	18. R tks B (ch)	K to B2
7. Castles	P to Q3 (*b*)	19. Kt to K5 (ch) (*l*)	K takes R
8. P takes P	B to Kt3	20. Q to R3 (ch)	K takes Kt
9. Kt to B3 (*c*)	Kt to B3 (*d*)	21. R to K sq. (ch)	K to B4
10. P to K5	P takes P	22. Q to Kt3 (ch)	K to B5
11. B to R3	Kt to R4 (*e*)	23. R to K5 mate.	
12. B tk P (ch) (*f*)	K takes B		

NOTES.

(*a*) B to B4 is considered a more reliable defence than B to R4.

(*b*) His best.

(*c*) Other good continuations are either 9. B to Kt2 or 9. P to Q5. The game would proceed as follows :—If 9. B to Kt2, K Kt to K2. 10. Kt to Kt5, P to Q4. 11. P takes P, Kt to R4. 12. P to Q6, Kt takes B. 13. P takes Kt, Q to Q4. 14. Kt to QB3, Kt takes B. 15. Kt takes Q, Kt takes Q. 16. R takes Kt, &c. If 9. P to Q5, Kt to R4. 10. B to Kt2, Kt to KB3, &c.

(*d*) Black may also reply with 9. Kt to R4, or 9. B to Kt5

(*e*) Now Black lays himself open to a strong attack. Had he played either 11. B to Kt5 or B takes P, White would have played 12. Q to Kt3.

(*f*) A sacrifice promising a strong attack.

(*g*) This move practically decided the game. Amateur ought to have played K to Kt sq., which would have given him a safe game.

(*h*) Threatening to win the Queen by discovered check with the Knight.

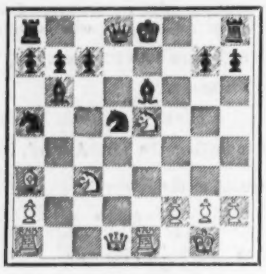
(*i*) Black might have played 15. P to B3 with the intention of exchanging Queens if White took the Bishop at once, which, however, he would not do, but play Q to R4 first, to be followed by QR to Q sq. Also 15. P to B4 commended itself, but White would likewise play Q to R4 (ch), forcing the Black King to play

XUM

to B sq., and then P takes B would again leave White with a superior game.

(*j*) If 16. Kt takes Kt, Q takes Kt. 17. Q takes Q, B takes Q. 18. Kt to Kt6 (ch), K to B2. 19. Kt takes R, R takes Kt. White's game would be much inferior to Black's. We give a diagram of the position :—

Black.



White.

Position after Black's 15th move.

(*k*) 17. K to Q2 would have been somewhat better, although White would still retain his superiority.

(*l*) Of course White can also win by Kt takes R (ch).

SOLUTIONS.

Problem No. 63, by G. Woodcock, p. 460.

1. Kt to Q6	1. K to K4
2. Q to KKt7	2. K tks KKt, or QKt, or K to Q5
3. Q to Kt3, or B7, or Q takes P mates accordingly.	

No. 64, by A. B. Palmer.

1. P to K3	1. R takes B (ch) best
2. K takes R	2. B to B2 or Q2 (ch)
3. K to Q6 or B6	3. B takes BP or KtP (acc.)
4. P mates.	

No. 65, by G. H. T.

This problem is incorrect. It admits of several solutions, such as 1. R takes P; also 1. Q to Q5 (ch) and 1. Q to K7.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

W.—Solutions all correct. We shall act upon your excellent suggestion.

C. Planck, J. A. Miles.—Problems received with thanks.

G. H. Bonner.—Solutions correct.

L. P. Rees.—Problem received with thanks. Solution correct. We shall be glad to receive your end position amended.

W. Jay, N. Brown.—Problems received with thanks.

G. H. T.—Solution of 63 incorrect.

Francis J. Drake, F. S. L., J. A. M., E. A. F.—Solutions correct.

Berrow.—1. R to QR5, K to Kt3. 2. R to QB5, K takes R?

Our Whist Column.

By "Five of Clubs."

GENERAL CONDUCT OF THE GAME.

WE have considered the various leads, both from strength and from weakness, and also so much of the sequent play of the suit led as serves to indicate the progress of the suit towards being established. This, of course, is the usual object of the play in each suit, whether the suit has first been led from strength or from weakness. Only, in one case the original leader and his partner seek to establish the suit, while in the other the suit may be (generally turns out to be) the adversaries', and *they* seek to establish it. We have now to consider the conduct of the game while the various plain suits are contesting, and afterwards, when, as the game proceeds, these suits, whether established or not, are worked by either side. We assume for the moment that the hands are so distributed that trumps are not led out very early on either side.

A suit is established when the holder of the strength in the suit has the best card or cards, with the certainty of drawing those intervening between it or them and lower ones. For instance, if in the first two rounds eight Hearts have fallen, including the Ace, Queen, Knave, and Nine, and I hold King, Eight, and Three, I know that two cards remain with the enemy; and if I know nothing more, my Hearts are not established, because, if I lead King, I am not sure that the Ten will fall; for one of the adversaries may hold both Ten and a small one, and playing the latter to my King will retain the command. But if the first two rounds have shown that the Ten is held single by one of the adversaries, I know it must fall to my King. I know this even if, besides the Ten, two other cards, one of them the Three, remain with the adversaries. My suit is therefore established, though I have but two cards left in it. The King will draw the Ten and the Three; the Eight will win the last trick in the suit.

The contest in plain suits manifestly turns on the acquisition of the command, in this way. So long as the enemy retains the command of my suit, in such sort that the next trick in the suit will go to them, any attempt to bring in the suit is of little avail. Suppose I get out all the trumps, and having then the lead, play a small card of my own suit. The enemy take the trick and bring in their suit. Nay, even if my partner has the commanding card of my suit,—alone,—my purpose is foiled; for he takes the trick, and cannot lead me my suit.

Thus we see that, in general, no attempt must be made to bring in a suit, even if strong, until the adversaries have been deprived of the command, or partner, if he has the command, has given it up. And viewing the matter from all sides—as holder of a strong suit, as adversary of such holder, and as his partner—we deduce the rules:—

1. Unless you have good cards of re-entry, as king-cards in the adversaries' suits, or good prospect of holding long trumps, do not try to bring in a suit of which you have not perfect command.
2. Keep the command of an adversary's suit.
3. Get rid of the command of a partner's suit.

(*To be continued.*)

The chief Editor has sent to us a letter from Benares, in which the writer asks that the Whist Column be discontinued, because—though he admits Whist is a fine game—"he got into the way of passing a quiet evening at Whist, when at Cambridge, not for money, but found far more wanted him to play at Loo and Vingt-Un." Our correspondent's logic is not very clear; but we suppose he considered those evenings wasted. Very likely. A little *good* Whist goes a great way; and two, or at most three, rubbers, closely and rather quickly played, are worth ten or a dozen rubbers of the bumble-puppy called Whist in many college rooms. There is no more risk of the readers of this column learning to waste time over Whist, than there is of the thousands who follow "Mephisto" going irretrievably to the dogs by playing Chess from noon to the small hours daily.

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